

Standardized Modeling of Connected Devices Drives Network Automation

IEEE 802 YANGsters work to set guidelines and harmonize efforts to use YANG models for connected devices in IEEE 802®-based networks.

by IEEE SA Working Groups

Communications networks are constantly evolving to cope with a range of ongoing challenges. These include more network-connected devices, faster and more reliable network performance, and the increasing need to deliver applications and services based on Time-Sensitive Networking, Software-Defined Networking, and cloud-based control, among other technologies.

Meeting these challenges quickly, effectively, and economically requires greater automation of network management and operation, but automation is difficult to accomplish when interconnected networks employ diverse protocols, data models, and practices. Standardized data models and protocols are required to move networks toward a more software-controlled, automated framework.

One way to do this is with an open network configuration protocol called NETCONF, and a modeling language designed for use with it called YANG. These have been developed and refined over more than two decades, and are being deployed within the IEEE 802® landscape of Ethernet and LAN/MAN standards.

IEEE 802 YANGsters

IEEE 802 YANGsters is the name of the group at IEEE Standards Association (IEEE SA) responsible for harmonizing and setting guidelines for IEEE SA projects that include YANG modules.

As a sub-group within [IEEE 802.1™](#), YANGsters also coordinate with other organizations involved with NETCONF/YANG modeling, such as the Internet Engineering Task Force (IETF), 3GPP, Broadband Forum, MEF, ITU-T, O-RAN Alliance, and others.

The development of NETCONF/YANG started in earnest in 2002, as a work product of the IETF (although much of its Ethernet-related NETCONF/YANG work has transitioned to IEEE SA over the years). IEEE SA and IETF work cooperatively and have monthly coordination meetings to ensure there is no duplication of effort.

YANGsters have adopted the IETF's YANG guidelines, and follow the latest work to augment and support vendor-agnostic IETF YANG modules in IEEE 802.1, [IEEE 802.3™](#), and [IEEE 1588™](#). (IEEE 1588 is a protocol for precise synchronization of clocks in packet-based networks.) The YANGsters also suggest using the IETF's Network Management Datastore Architecture (NMDA) for IEEE YANG modules to simplify the YANG module architecture.

Powerful tools for automated network management

NETCONF is used to configure network-connected devices and to request information from them, while YANG is used to create the models NETCONF uses to understand both the

configuration and state data of networked devices. NETCONF enables network administrators to centrally manage networked YANG devices, simplifying operations and reducing operating costs.

Together, NETCONF and YANG overcome many deficiencies of the traditional, widely used Simple Network Management Protocol (SNMP). For example, while SNMP supports configuration and monitoring, it doesn't support key requirements of software-controlled networks such as easy extensibility and the ability to "roll back" when there is a configuration error.

This is vital to network automation because when pushing a configuration to a network device, there are potentially hundreds of objects that need to be set individually. With SNMP, if just one fails, the system will be in an inconsistent state. Using NETCONF/YANG for configuration, however, sends all configurations as a single transaction, so that if something fails the system is restored to its original state.

NETCONF/YANG also enables users to manage different configuration datastores (i.e., data collections) concurrently. Thus, on one device, there can be the running configuration (the configuration currently active on the device); a candidate configuration (a configuration the operator wants to apply); and an operational state datastore (which contains the state data for the running system), all of which can be present concurrently. NETCONF provides the tools to manipulate each datastore independently in an easy-to-read format while leveraging YANG as the common language for all datastores.

However, it is important to note that not all YANG modules follow the same YANG version. There are two versions of YANG (version 1.0 and version 1.1), with some incompatibilities between them. For the most part, it is possible to have an effective network containing YANG 1.0 and YANG 1.1 modules, but a key issue is that YANG 1.0 does not work with the IETF's Network Management Datastore Architecture. The absence of NMDA support makes the YANG models cumbersome because state data is stored differently than configuration data, leading to unnecessary duplication of data for a given YANG model. For that reason, YANGsters recommend the use of YANG 1.1 for IEEE 802 YANG modules.

Learn More and Get Involved

Even though YANGsters has been operating since 2017, and NETCONF/YANG has been under development for many years, there is still much work to be done, especially in scalability, telemetry, security, and tooling.

The YANGsters group is IEEE SA's center of competence for the network modeling needed for future bridging and Ethernet enhancements, which will enable the realization of future self-managing, service-driven, virtual, and cloud-based network environments.

Anyone wishing to learn more about YANGsters, or desiring to become a YANGster, can visit our [website](#), or contact us directly at the email addresses below.

###

Authors:

- Scott Mansfield, YANGsters Chair, and Standards Researcher at Ericsson, Inc. scott.mansfield@ieee.org
- Stephan Kehrer, YANGsters Vice Chair and Secretary, and Senior Technology Architect at Belden, Inc. stephan.kehrer@belden.com